

**FEASIBILITY OF  
MECHANICAL PRICE MARKING  
OF GROCERIES  
AT THE CENTRAL WAREHOUSE**

**Marketing Research Report No. 872**

**Agricultural Research Service  
UNITED STATES DEPARTMENT OF AGRICULTURE**



## Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

## PREFACE AND ACKNOWLEDGMENTS

The research on which this report is based was conducted under contract by the Food Business Institute of the University of Delaware.

Chester Gibbons of the Guide Company made available for evaluation the prototype price-marking equipment used in this study, and the Kutz-Kwik Company provided a case cutter. The building and the grocery items used in the tests were made available to the University of Delaware by the Hearn Brothers Super Food Stores. The retailing and wholesaling firms who provided data and suggestions were: Acme, The Great Atlantic and Pacific Tea Company, Penn Fruit, Shop-Rite, Wakefern, and Thriftway. These firms were very helpful in uncovering problem areas and suggesting solutions.

## CONTENTS

|   | <i>Page</i> |
|---|-------------|
| Summary .....   | 1           |
| Introduction .....  | 2           |
| Objectives, methodology, and basic assumptions .....                                | 4           |
| Objectives .....  | 4           |
| Methodology .....   | 4           |
| Basic assumptions .....   | 4           |
| Standard operating procedures .....   | 5           |
| Case openers—productivity and costs .....   | 5           |
| Price marking—productivity and costs .....  | 6           |
| Equipment and space costs .....   | 10          |
| Comparative cost of price marking at the warehouse and<br>at the retail store ..... | 11          |
| Suggested operating methods and warehouse layout .....                              | 13          |
| Considerations with warehouse price marking .....                                   | 13          |
| Shipping split cases .....  | 13          |
| Handling price changes .....  | 15          |
| Effects of warehouse pricing on retail inventories .....                            | 16          |
| Consumer reaction to multi-impression mechanical price marks .....                  | 16          |
| Extent of zone pricing .....  | 17          |
| Need for additional research .....  | 17          |
| Literature cited .....  | 18          |
| Appendix .....  | 18          |

# FEASIBILITY OF MECHANICAL PRICE MARKING OF GROCERIES AT THE CENTRAL WAREHOUSE

By Harry F. Krueckeberg<sup>1</sup> and Robert L. Bailey  
Food Business Institute, University of Delaware, and  
John C. Bouma, Transportation and Facilities Research Division  
Agricultural Research Service

## SUMMARY

A grocery warehouse with a \$40 million annual volume could save approximately 150 man-hours daily, or \$86,000 annually, by pricing grocery items mechanically at the warehouse instead of pricing them by hand at the retail store. These savings, if applied to all grocery shipments in the United States, would total about \$54 million annually. Savings with warehouse mechanical price marking, in contrast to conventional in-store price marking, are dependent on when the price marking is done, the volume of merchandise price-marked mechanically, the extent of zone pricing, and the frequency and number of price changes. For example, if the firm required four separate prices for each item, annual savings with mechanical warehouse pricing would be reduced by more than 22 percent.

The analysis of mechanical warehouse price marking in this study is based on a hypothetical warehousing firm with a \$40 million annual grocery volume. The firm's shipments are assumed to be equally divided among 5 days of each week. Twenty percent of the items require hand stamping, a function accomplished at the retail store, and 30 percent of the cases must be opened by hand. Presumably, 70 percent of the items are double-layer cases and 30 percent are single-layer cases. The wage scale at the retail store, for purposes of this analysis, is \$2.60 per hour and \$3 per hour at the warehouse.

<sup>1</sup> Mr. Krueckeberg is now Director, Bureau of Business Research, Indiana State University.

Although research indicates that mechanical price marking would be less costly than conventional hand stamping methods, problems associated with central warehouse mechanical price marking need to be resolved.

One problem associated with this price-marking process results from the requirement that the tops of all single-layer cases be removed and all double-layer cases be split during mechanical pricing. Because special handling is required for the transport of opened and split cases, the retailer customarily orders in full-case quantities. If the warehouse pricing process becomes prevalent, efficient and economical methods of handling and transporting opened and split cases must be found. Several promising approaches to the transport problem are discussed in this report, and others should be elicited by the development of warehouse mechanical pricing.

Warehouse pricing would also affect a major problem that confronts retail management — the problem of making the numerous changes of price that are required as a result of the grocery industry's price-changing policies. This study determined that the most efficient and productive mechanical price-marking equipment available is the multi-impression price marker. Because this equipment covers the entire top surface of an item with alternate rows of large and small price figures, it produces price marks that are difficult to change.

Although several ways of minimizing the problem of repricing grocery items price

marked at the warehouse were suggested by cooperating grocery firms interviewed during this study, no ready solution to the problem can be offered. The most feasible way for the retailer to avoid excessive repricing of warehouse-priced merchandise seems to be for him to maintain a good inventory control system in which minimum time is allowed to elapse between the preparation of retail orders and the stocking of retail store shelves.

The most important advantage offered by mechanical warehouse pricing is that it would facilitate the practice of shipping half-case quantities of grocery items. Because all double-layer cases must be split during the mechanical price-marking procedure, implementation of this system of pricing at the warehouse level would produce readily available half-case quantities of merchandise for retail order filling. With conventional procedure, the retailer must order all dry grocery items in caseload quantities. To minimize the time and labor required to look for partly filled cases in the backroom and to move small quantities of items between the backroom and the shelf, the retailer generally apportions his shelf space so that caseload quantities can be accommodated in the space allocated to the units of each item carried by the store. Cases of slower moving products frequently become overstocked in the backroom and this merchandise occupies space on the shelf that could be more profitably occupied by other products. The slower moving items also increase the retailer's handling requirements, and they are particularly vulnerable to price changes. If the retailer could reduce his inventory by ordering his merchandise in half-case quantities, he should be able to alleviate handling and repricing problems, and he should also

be able to more nearly allocate his shelf space in accordance with item sales performance and thus accelerate sales in underproductive areas of the store.

It can be concluded, therefore, that the central mechanical price-marking process promises to (1) effect substantial savings in the time and labor costs required for the price-marking function; (2) encourage the maintenance of sound retail inventory management; and (3) promote the use of half-case units in retail ordering and warehouse shipping and thus make it more feasible for the retailer to stock smaller quantities of grocery items.

The problems associated with central warehouse mechanical price marking indicate the need for additional research in other areas of the grocery distribution system. The problem of price changing, for example, indicates the need for reevaluating the whole area of the food industry's price-changing policies. Research is needed to determine the feasibility of using automatic case-opening equipment with mechanical price-marking equipment, and attention should be directed toward the feasibility of modifying carton design and warehouse layout to facilitate mechanical price marking. Possibly, efficient and productive mechanical price-marking equipment could be developed that would provide a type of price mark that could be more easily changed. Studies are also needed to evaluate the effectiveness of warehouse mechanical price marking in reducing errors during the checkout operation, and to determine the feasibility of extending this pricing system to other than dry grocery items. Finally, research is needed to determine the feasibility of using optical scanning equipment for the development of a coded central price-marking system.

## INTRODUCTION

The 227,000 retail food stores in the United States have an important role in the Nation's economy. In 1968, according to trade estimates, their combined sales were \$77.7 billion; the consumer spent 75 percent of his food dollar in the Nation's retail food stores.

Any reduction in the cost of distributing food products can either benefit the consumer through lower prices, or allow the retailer to render more and better service. Improved methods of handling groceries offer an opportunity for substantial savings to the retail food store

and thus offer potential benefits to the consumer.

An estimated 5 billion cases of grocery products are moved each year from grocery warehouses into retail food stores.<sup>2</sup> Approximately 60 percent of the cost of moving these products from the warehouse slot to the retail-store shelf is incurred at the retail store (7).<sup>3</sup> During one study, Harwell and Shaffer (5) found that about one-third of the total store man-hours (excluding the check-out operation) were devoted to handling the various grocery items stocked by the retailer. These authors also reported that 22 percent of the labor in man-hours required by the grocery department was expended on the price-marking function. Reducing the costs of the price-marking function, therefore, is an important consideration in the grocery industry's efforts to reduce the overall cost of retailing.

Although the price-marking requirement extends to all items carried by the retail store, improved methods of discharging this requirement are most feasibly directed toward the store's "dry grocery" items. Dry grocery items are those items that are canned, boxed, or glass-packed. These items account for approximately 45 percent of food-store dollar sales and thus represent a sizable part of the price-marking requirement.

Dry grocery items are generally packed into cases at the manufacturing or processing plant and are handled as case units, rather than as individual units, while they are in the grocery warehouse. Customarily, the retailer orders from the warehouse in caseload quantities. When these orders are received in the retail store, a case that originally figured as one unit becomes 12, 24, or 48 units of individual grocery

products. In virtually all retail stores, each unit is individually price marked and individually handled in the stocking operation. Thus, handlings in the store are more numerous than handlings in the warehouse.

A retail store usually assigns several stock clerks to the price-marking function. As this function is ordinarily performed, the probability of marking errors is high. Many stock clerks use a band-type adjustable stamp that is less efficient and more likely to produce illegible prices than self-inking porous-tip stick stamps. The combination of a large number of items requiring pricing, a large number of stock clerks assigned to this function, and a frequent dependence on poor price-marking equipment increases the probability of marking errors and of illegible markings.

The central warehouse mechanical price-marking process described in this report offers a method whereby marking errors and illegible price marks can be minimized, and the retailer can be relieved of a major man-hour handling requirement. Some large grocery firms have set up price-marking systems in which certain non-grocery items, such as clothing and housewares, are priced at the warehouse. In most instances, however, these items are specialty products with individual pricing requirements, or they are products that cannot feasibly be packaged in individual containers for use with mechanical price-marking equipment. Research indicates that such equipment offers the greatest potential savings for systems in which merchandise is priced at the warehouse level, and experiments conducted in 1967 for this study with the two types of mechanical price markers available to the researchers (described later in this report) indicate that the uniformly packaged units of dry grocery items are suitable candidates for use with mechanical price-marking equipment.

Application of warehouse mechanical price marking to dry grocery items is still in the research stage. However, it seems probable that the grocery industry will show continuing interest in a price-marking process that offers savings that could result in expanded consumer services and reduced prices in the retail store.

<sup>2</sup> Handling time per case ranges from 3 to 6 man-minutes, according to methods used. If this time were reduced by 1 minute and the time saved were used effectively, retailers could realize an annual savings in food-handling costs of \$260 million (based on annual grocery sales of \$30 billion, case value of \$5, and hourly wage rate of \$2.60).

<sup>3</sup> Italic numbers in parentheses refer to Literature Cited, p. 18.

## OBJECTIVES, METHODOLOGY, AND BASIC ASSUMPTIONS

### Objectives

The objectives of this study include: (1) determining equipment available for price marking grocery products by machine; (2) obtaining production rates and costs for machine-performed pricing; (3) developing layouts, operating procedures, and cost estimates per case for central warehouse pricing that compare with those used for conventional pricing methods; (4) determining the extent of zone pricing (assigning the identical units of an item to different price categories) and frequency of price changes, and the effect of these factors on central price marking; and (5) evaluating consumer reaction to the particular type of price marks produced by the equipment used during this study (the multi-impression price marker).

### Methodology

To evaluate the feasibility of price marking groceries by machine at the central warehouse, the researchers had first to determine whether such machines are available. Inquiries were made of 13 equipment manufacturers concerning the availability of machines for case cutting and price marking. The available equipment had to be tested and productivity and costs had to be measured through the development of an experimental handling and pricing line where case-cutting and mechanical price-marking equipment could be observed in use. Produce-flow analyses from these experimental observations and findings from previous research in grocery warehouses were used to simulate product handling from receipt to the pricing line, and from the pricing line to order assembly. The results of this research were used to develop the suggested layout for the pricing operation. Six firms were contacted to determine the extent to which zone pricing was used, and the amount of repricing required because of price changes. Finally, consumer acceptance tests were conducted in one supermarket for 1 week to determine whether the consumer would be willing to accept the multiple price marks produced by the experimental price-marking equipment.

Operations requiring labor, such as case cutting, were afforded time studies and the average time required for each element of the operation became the basis for developing a standard time. A rating factor was applied, based on the effective speed at which the operator worked, to obtain the base time. A fatigue and personal allowance of 15 percent was then added to the base time established for each operational element to convert an operator's actual performance to normal performance. The time thus established is standard time (1).

### Basic Assumptions

From these investigations, the researchers were able to analyze the time, labor, and operational requirements that would be involved in opening and price marking cases by machine. To make meaningful comparisons between conventional manual case opening and pricing and mechanical case opening and pricing, a hypothetical warehouse operated under the following assumptions was postulated:

1. The annual dry grocery volume was \$40 million, equally divided into shipments of 30,769 cases daily, 5 days per week.
2. The firm handled 3,600 dry grocery items and delivered 30 store orders daily, 5 days per week.
3. Four zone prices were used and an equal number of cases were delivered to each zone daily.
4. Seventy-five percent of all items stocked were sold in quantities of one case, 20 percent were sold in quantities of two cases, and 5 percent were sold in quantities of three cases.
5. Twenty percent of all items required hand stamping and 30 percent of all cases had to be opened by hand.
6. Seventy percent of all items were packed in double-layer cases averaging 45.5 inches in circumference and 30 percent were packed in single-layer cases averaging 60.5 inches in circumference.
7. The wage scale at the retail store was \$2.60 per hour and at the warehouse, \$3 per hour.

## STANDARD OPERATING PROCEDURES

In all grocery warehouses supplying retail stores, the merchandise ordered by the retail stores is assembled from warehouse stock on pallets, four-wheel selector trucks, plywood sheets, or conveyor lines. The merchandise is then loaded on delivery trucks for shipment to the stores. The warehousing function is basically one of buying merchandise in relatively large quantities from manufacturers and of shipping smaller quantities, generally single cases, to retail stores. Between 5,000 and 7,000 grocery items are handled in the typical grocery warehouse (6).

Grocery merchandise is usually transported from the warehouse to the retail store on tractor-trailer trucks, and the merchandise is unloaded into the store's backroom. In most stores, the merchandise is received on conveyor lines and is placed in rows segregated by commodity groups by the receiving crew. However, when retail-store grocery orders are assembled

and transported on pallets, the palletloads of groceries are transported into the store's backroom by pallet jack or forklift truck.

After receipt of the groceries into the store's backroom, the next function is to price mark the individual items. The price-marking function is performed at various times and places in individual firms, and sometimes in units of the same firm (7).

Cases are customarily price marked either at the warehouse, with adhesive labels, or on receipt at the retail store (3). Individual cans or packages can be price marked as they are received at the store, in the backroom as they are needed, or at the shelf during the stocking operation. Whether the pricing of individual packages or cans is performed in the backroom or near the assigned shelf, the merchandise must be moved from the backroom to the shelf and the individual items must be placed on the retail-store shelf in ready-for-sale position.

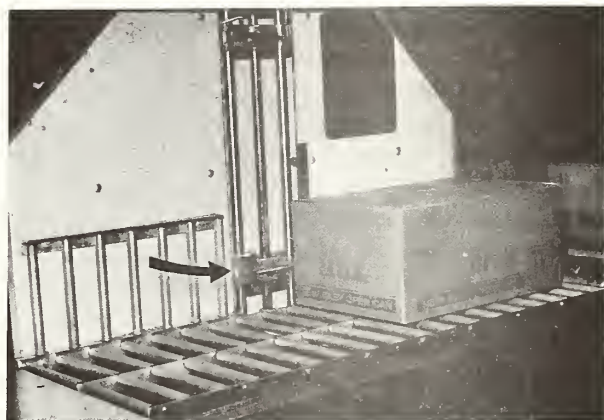
## CASE OPENERS—PRODUCTIVITY AND COSTS

Dry grocery items received into the central warehouse are packaged by the processor or manufacturer in cardboard cases that are sealed at the plant. Customarily, the items remain sealed in the cases while they are stored in the warehouse, and are shipped to the retail store in the same unopened cases. However, when the items are mechanically priced at the central warehouse, the tops must be removed from all single-layer cases and all double-layer cases must be split in halves so that all items can be exposed to the mechanical price marker.

The usual method of opening cases involves using a hand-operated tool that is relatively slow and laborious to operate. The case opener used in this study is an electrically operated all-purpose model equipped with two cutting heads. These heads can be used independently for making single cuts, or together for making tray-type cuts. The all-purpose case opener can be used to open all cases containing products with round corners. Such products compose approximately 70 percent of the items stocked by most

grocery warehouses. This cutter, shown in figure 1, costs \$550.

Time studies were made to determine the productivity of manual and mechanical case cutting. The basic assumption used to measure case-cutting productivity for the hypothetical



BN-36570

FIGURE 1.—An electrically operated all-purpose case cutter. The cutter head (arrow) is shown in operation.

warehouse with its assumed 30,769-case-per-day shipping volume was that 70 percent of the items would be packed in two-layer cases and 30 percent would be packed in single-layer cases. Table 1 shows a comparison of productivity in cutting cases as a warehouse and as a retail-store operation.

As shown in table 1, productivity in cutting cases by machine at the warehouse is 339 cases per man-hour, a figure nearly 36 percent greater than the 250 cases per man-hour accomplished with manual case cutting at the retail store. In all probability, improvements in case cutters can be developed that will further increase productivity with mechanical case cutters.

Production standards for mechanical cutting

of cases were based on extensive time studies. From these studies a formula was developed to provide a standard for cutting any size of case in any given quantity. The formula for determining productivity in cutting single-layer cases is as follows:  $Y = 0.0019 (2L + 2W) + \frac{0.038}{N}$ . In the formula,  $Y$  equals the time required to cut a given number of cases,  $L$  equals the length of the case,  $W$  equals the width of the case and  $N$  equals the number of cases to be cut. Appendix table 4 gives the standard time for cutting single-layer cases of various dimensions. The formula for productivity in cutting double-layer cases is as follows:  $Y = 0.0029 (2L + 2W) + \frac{0.038}{N}$ .

TABLE 1.—*Productivity of mechanical case cutting and hand case cutting at warehouse and at retail store*

| Case-cutting operations and productivity per man-hour | Mechanical case cutting<br>at warehouse |                           |                   | Hand case cutting<br>at store |                   |
|---|---|---------------------------|-------------------|-------------------------------|-------------------|
|   | Time per<br>operation <sup>1</sup>      | Frequency<br>of operation | Weighted<br>time  | Frequency<br>of operation     | Weighted<br>time  |
|   | <i>Man-minute</i>                       | <i>Percent</i>            | <i>Man-minute</i> | <i>Percent</i>                | <i>Man-minute</i> |
| Open case and dispose of top by machine.....          | 0.1150                                  | 16.8                      | 0.0193            | .....                         | .....             |
| Cut case in half by machine.....                      | .1320                                   | 39.2                      | .0517             | .....                         | .....             |
| Open case and dispose of top by hand.....             | .1970                                   | <sup>2</sup> 13.2         | .0260             | 30.0                          | 0.0591            |
| Cut case in half by hand.....                         | .2590                                   | <sup>3</sup> 30.8         | .0798             | 70.0                          | .1813             |
| Total.....  | .....                                   | 100.0                     | .1768             | 100.0                         | .2404             |
| Standard case-cutting productivity per man-hour.....  | <i>Number</i><br>339                    |                           |                   | <i>Number</i><br>250          |                   |

<sup>1</sup> Includes a 15-percent personal and fatigue allowance.

<sup>2</sup> Assumes 6 percent of the case tops would be removed by hand at the retail store and 7.2 percent at the warehouse.

<sup>3</sup> Assumes 14 percent of the cases would be cut in half at the retail store and 16.8 percent at the warehouse.

## PRICE MARKING—PRODUCTIVITY AND COSTS

Time studies conducted in numerous cooperating retail stores showed that with improved work methods, employees required an average of 0.010 man-minute to price mark each item unit, whether prices were marked at the receiving station, in the backroom, or at the shelf.

The mechanical price marker used in this study is a multi-impression marker (fig. 2) that is relatively simple in design. The multi-impression marker will price mark any grocery item with an exposed surface—generally, items in single- or double-layer cases. A pricing roll (fig.

3) is used to mark each of the individual units in a given layer. The outer surface of the roll is covered with numerous price impressions in two sizes, placed alternately around the roll. The purpose of using multiple impressions is to assure greater variety in the products that can be price marked. When a multi-impression marker is used, the tops of all units are covered with both large and small prices (fig. 4) and each unit is assured of receiving at least one legible price mark.



BN-36569

FIGURE 2.—The multi-impression price-marking system.

The multi-impression price marker is operated by the action of the open case, which is moved horizontally by a flight conveyor. The case is conveyed to the marker from the right side and is passed under the pricing roll. Just before it passes under the pricing roll, it slides over a microswitch that causes a plastic inking roll (top, fig. 5) to drop and contact the pricing roll (bottom, fig. 5). The inking roll parallels the pricing roll and is motor driven in a counter-clockwise direction. Ink is gravity fed onto the inking roll which, in turn, inks the pricing roll. Enough time is allowed for the pricing roll to be completely covered with ink before the case passes beneath. Each item in the case comes in contact with the pricing roll before the case is discharged at the left of the marker.

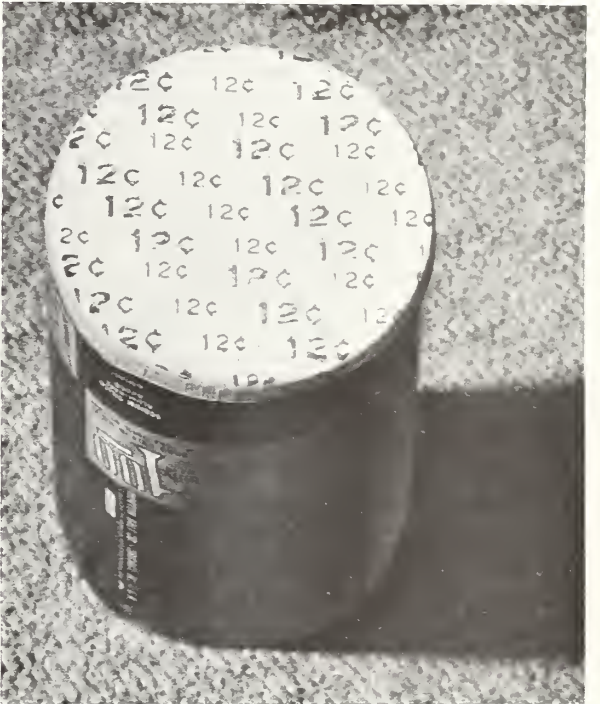
Productivity of the multi-impression price marker varies with the number of cases price marked, as well as the case size. The pricing roll must be changed every time another item with a different retail price is marked. A total of 0.156 man-minute is required to change the pricing roll; hence, productivity for pricing one case would be less than for 2 or more cases, if these were price-marked in one run. As shown in table 2, approximately 90 percent of the man-hours required for price-marking could be saved by using the mechanical multi-impression marker instead of the best known manual price-marking methods, if 30 or more cases were priced in each run.

Specifications for the multi-impression price-marker are shown in appendix table 5.



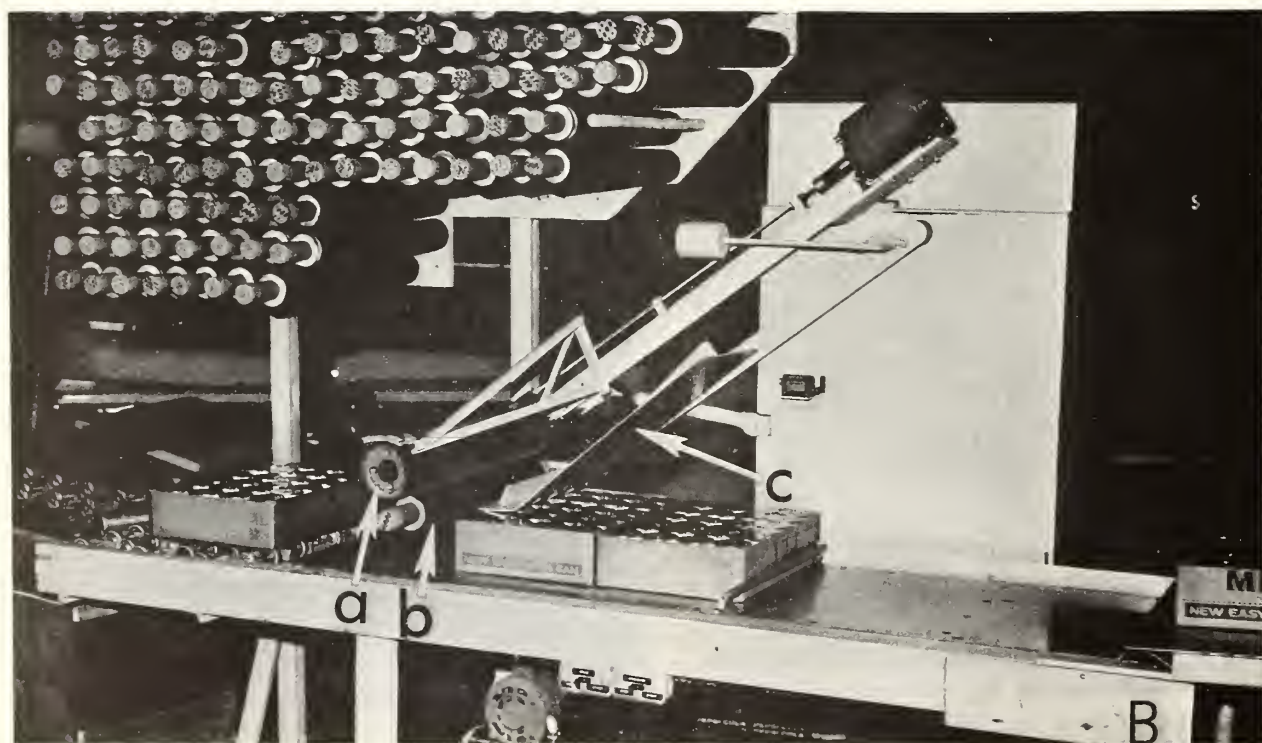
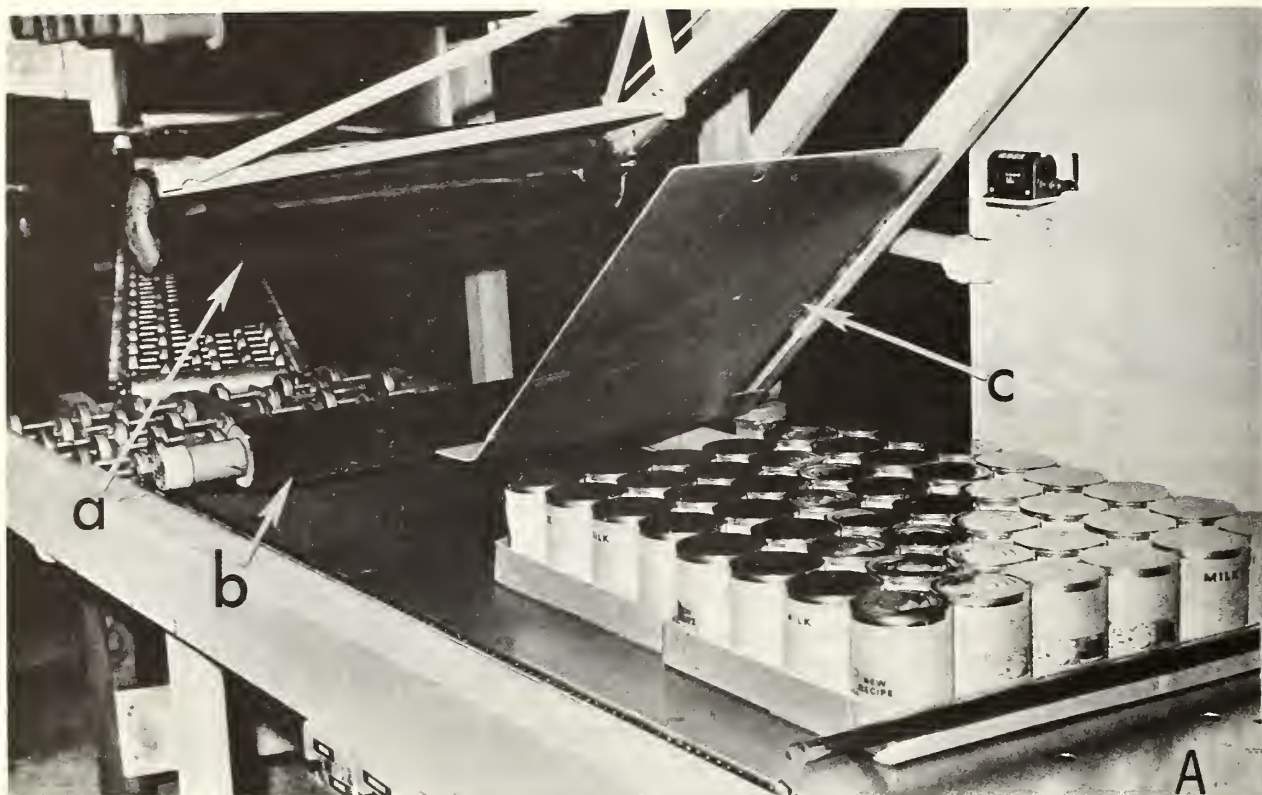
BN-36562

FIGURE 3.—Pricing roll without marker (A), pricing roll with marker inserted (B), and multi-impression marker used on pricing roll (C).



BN-36563

FIGURE 4.—Price marks placed on a package by the multi-impression mechanical marker.



BN-36568, BN-36567

FIGURE 5.—Position of inking roll (*a*) and pricing roll (*b*) before price marking (*A*) and during the price-marking process (*B*). The weight of the price marker is counterbalanced by a stabilizer (*c*).

TABLE 2.—Standard required time to price-mark single- or double-layer cases of groceries with machine and with manual methods<sup>1</sup>

| No. of cases, case size and No. of units per case | Pricing method      |            | Time savings with machine pricing |         |
|---|---------------------|------------|-----------------------------------|---------|
|   | Manual <sup>2</sup> | Machine    |                                   |         |
|   | Man-minute          | Man-minute | Man-minute                        | Percent |
| 30 cases:   |                     |            |                                   |         |
| 1-layer, 24 units ..                              | 0.2400              | 0.0220     | 0.2180                            | 90      |
| 2-layers, 48 units ..                             | .4800               | .0388      | .4412                             | 92      |
| 70 cases:   |                     |            |                                   |         |
| 1-layer, 24 units ...                             | .2400               | .0190      | .2210                             | 92      |
| 2-layers, 48 units ..                             | .4800               | .0358      | .4442                             | 92      |
| 100 cases:  |                     |            |                                   |         |
| 1-layer, 24 units ...                             | .2400               | .0184      | .2216                             | 92      |
| 2-layers, 48 units ..                             | .4800               | .0352      | .4448                             | 92      |
| 1,000 cases:                                      |                     |            |                                   |         |
| 1-layer, 24 units ...                             | .2400               | .0169      | .2231                             | 92      |
| 2-layers, 48 units ..                             | .4800               | .0337      | .4463                             | 92      |

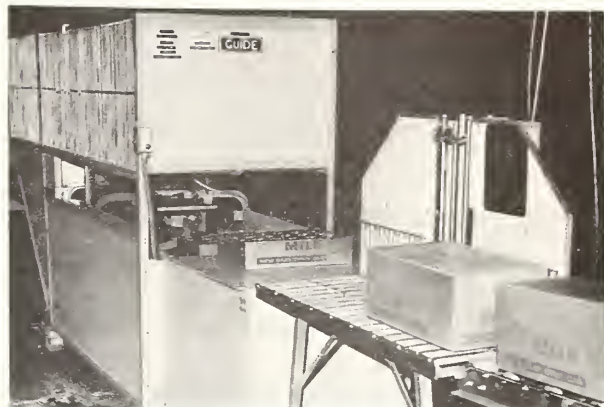
<sup>1</sup> All units in each case were assigned the same price.

<sup>2</sup> See (7).

Another machine, called a "single-impresion price marker," was originally designed for price marking grocery items at the warehouse. This machine, shown in figure 6, was not completely analyzed in this study because its productivity, as reported by the designer, is fixed at eight cases per minute, making it more costly than the multi-impresion marker. This machine receives a single case layer or a split case at one end, moves the case horizontally, and elevates it to a point of contact with a price-marking plate. Each unit in the case contacts the price-marking plate and receives a single price impresion. The case is then lowered and moved horizontally out of the other end of the machine.

With the single-impresion marker, the price is applied by molded round rubber buttons, similar to those in the marker used on stick-type stamps; these are fastened to a plate by springs. The springs allow the price buttons to contact the items evenly and with the proper force. The entire price plate is inked by a moving ink pad before its contact with each case. Figure 7 shows the price-marking plate.

One of the disadvantages of the single-impresion marker is that it requires a separate pricing plate for each pattern to be applied, as well as separate plates for different prices. Because of this requirement, a large number of



BN-36566

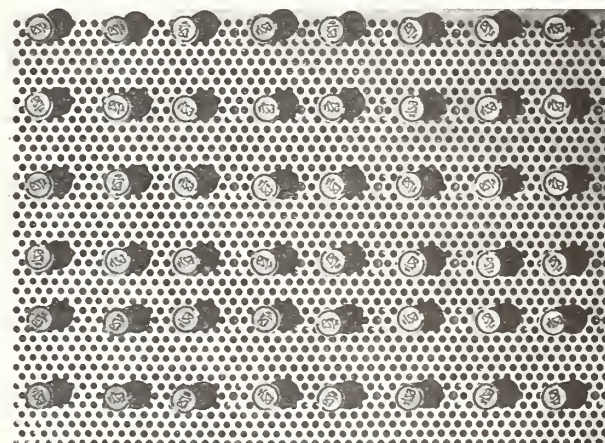
FIGURE 6.—Single-impresion price marker and case cutter.

plates must be stored over the machine for ready access to the machine operator.

Specifications for the single-impresion price marker are given in appendix table 5.

Extensive time studies were made of the mechanical price-marking operation. From these studies, a formula was developed to provide a standard for price-marking groceries that takes into account the case size as well as the number of cases with identically priced contents. The formula for determining productivity of mechanical price-marking is as follows:  $T = (0.0021)(W) + \frac{0.156}{N}$ . In the formula,  $T$  equals

the time in minutes required to price mark,  $W$  equals the width of the case in inches, and  $N$  equals the number of the single-layer cases, or twice the number of double-layer cases of the



BN-36565

FIGURE 7.—A price-marking plate used with the single-impresion mechanical marker.

same size, to be marked with the same price. The decimal 0.0021 is the man-minute time required to price mark 1 inch of case width and the decimal 0.156 is the man-minute time re-

quired to change the pricing roll. Appendix table 6 gives the man-minutes required to price mark varied lots of cases ranging from 8 to 16 inches in width.

## EQUIPMENT AND SPACE COSTS

The amount of case-cutting and mechanical price-marking equipment and the amount of space required is determined by the frequency of price marking as well as the size of the business. For illustrative purposes in this study, it is assumed that groceries will be price marked daily and the warehouse will handle approximately \$40 million annually. Assuming an average case value of \$5, 8 million cases would be shipped annually—153,846 cases weekly, or 30,769 daily. Presumably, unpriced groceries would be assembled, price marked, and distributed to bays for each store order on a daily basis.

The equipment needed for each pricing line, the initial cost, and the depreciation rate are shown in table 3.

Two pricing lines would be needed for the hypothetical warehouse discussed in this study, in view of the basic assumptions that 30,769 cases of groceries would be shipped daily and that 80 percent (24,615) of the merchandise would be price marked by machine. As shown in figure 8, two pricing lines require 1,260 square feet of floor space.

In addition to the 1,260 square feet of floor space needed for two pricing lines in a grocery

warehouse with a \$40 million annual volume, additional space would be needed for dispersing the priced merchandise into the 30 store orders. Space would be needed for holding the priced merchandise, grouped in store orders, until all of the merchandise was priced and trailers were available for loading. Since 30,769 cases of groceries would be shipped daily and 80 percent, or 24,615 cases, would contain merchandise to be price marked before shipping, space would be needed to provide for the 24,615 cases that would be distributed among 30 stores. Assuming that the priced merchandise would be placed on pallets by store orders, space for approximately 16 pallet loads of priced merchandise would have to be provided for each store. Palletized and priced merchandise for each store could be placed in two 8-deep floor slots. These slots would require approximately 7,680 feet of floor space, basing requirements on 16 square feet per pallet, 16 pallets per store, and 30 stores. Thus, the additional space required by a warehouse pricing system would total 8,940 square feet, including 7,680 square feet for holding assembled priced merchandise and 1,260 square feet for the pricing operation.

Food-distribution industry data on annual building costs, including light, heat, taxes, repairs, and rent, show an average of 0.48 percent of sales for firms with sales of \$25 to \$50 million annually (2). With a \$40-million grocery volume, warehouse building cost would total \$192,900 annually. Assuming that this volume would be handled in a 200,000-square-foot grocery warehouse, the building cost would average \$0.92 per square foot. Thus, the added 8,940 square feet of space for the warehouse pricing operation would total \$8,225 annually.

In addition to the space cost, the annual depreciation for the pricing equipment for two lines would total \$2,864. Thus, the estimated annual cost for equipment and space totals \$11,089.

TABLE 3.—*Equipment cost and depreciation for mechanical case-cutting and price-marking equipment*

| Equipment                          | Initial cost | Years depreciated | Annual depreciation |
|------------------------------------|--------------|-------------------|---------------------|
|                                    | Dollars      | Number            | Dollars             |
| Multi-impression price marker..... | 4,700        | 5                 | 940                 |
| All-purpose case openers (2).....  | 1,100        | 5                 | 220                 |
| Case divider.....                  | 1,200        | 5                 | 240                 |
| Conveyors (4).....                 | 214          | 10                | 21                  |
| Conveyor stands (6).....           | 55           | 10                | 6                   |
| Case stop.....                     | 54           | 10                | 5                   |
| Total cost.....                    | 7,323        | —                 | 1,432               |

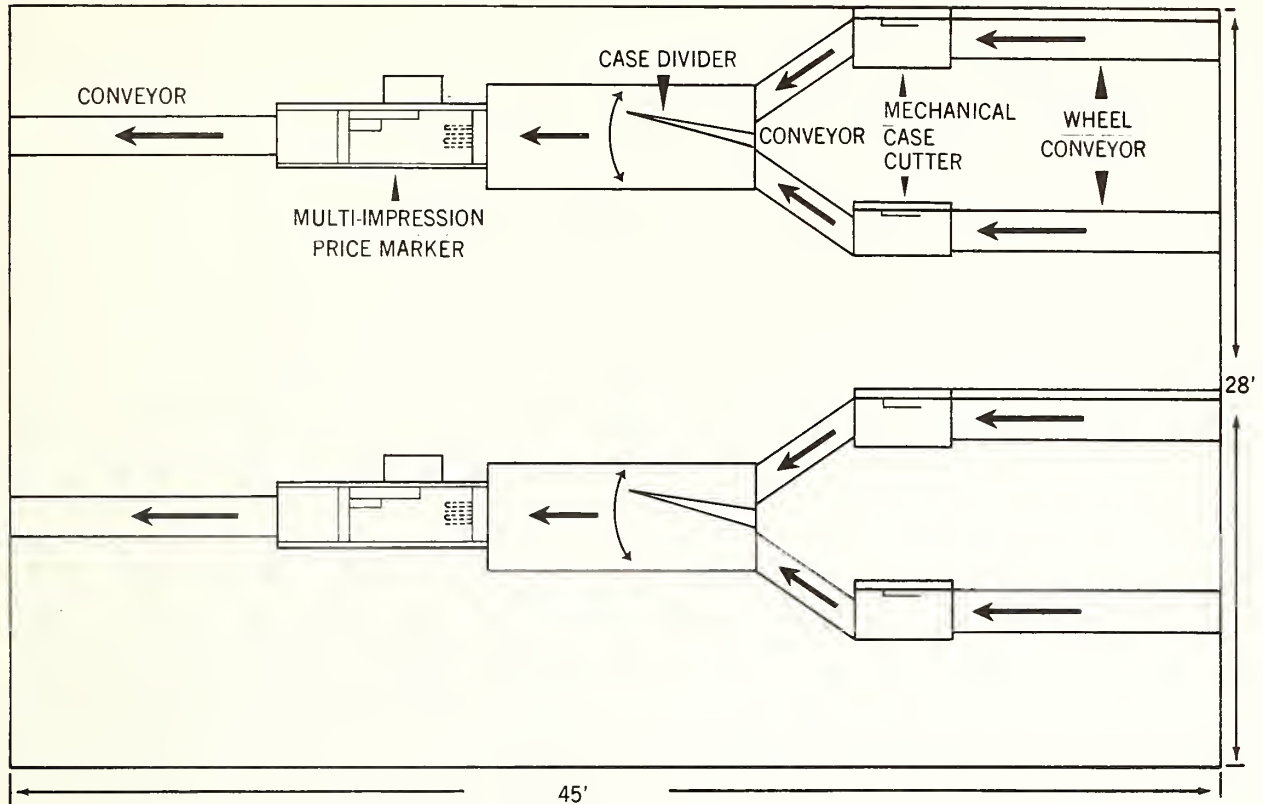


FIGURE 8.—Suggested layout, equipment, and flow pattern for a mechanical price-marking operation in a grocery warehouse using two pricing lines.

## COMPARATIVE COST OF PRICE MARKING AT THE WAREHOUSE AND AT THE RETAIL STORE

The standard time for cutting cases and pricing single- and double-layer cases of merchandise at the retail store with the best known hand methods has previously been determined to be 0.527 man-minutes per case (7). If 30,769 cases were shipped daily from the warehouse, a total of 16,215 man-minutes (270.3 man-hours) would be required for opening and price marking the merchandise by hand at the retail store. With a wage scale of \$2.60 per man-hour, the cost of opening cases and price marking case contents would total \$702.78 daily, or \$182,670.80 annually.

Using the basic assumptions for this study—3,600 dry grocery items handled by the firm and 30,769 cases shipped per day to 30 stores—the following items would be sold in assumed case quantities:

2,700 items (75 percent) in one-case lots per item,  
 720 items (20 percent) in two-case lots per item, and  
 180 items (5 percent) in three-case lots per item.

With the foregoing assumption, each item would be included at least once in every 4,680 cases shipped. This estimation was calculated as follows:

(2,700 items x 1 case) plus (720 items x 2 cases) plus (180 items x 3 cases) = 4,680.

If the number of cases shipped each day (30,769) is divided by the number of cases required to insure that each item is shipped once (4,680), it can be calculated that each item would be shipped in lots of 6.57 cases per day. Therefore, each item shipped in one-case lots would be sold in average quantities of 6.575

cases a day; each item shipped in two-case lots, 13.15 cases a day; and each item shipped in three-case lots, 19.72 cases a day.

Since it is assumed that 20 percent, or 720, of the 3,600 items will be hand stamped at the retail store, 2,880 items will require mechanical price marking at the warehouse, in the following case-lot quantities daily:

|                                  |                    |
|----------------------------------|--------------------|
| 2,160 (1-case lot) ; 6.575 cases |                    |
| marked daily—14,202 cases        |                    |
| 576 (2-case lot) ; 13.150 cases  |                    |
| marked daily— 7,574 cases        |                    |
| 144 (3-case lot) ; 19.72 cases   |                    |
| marked daily— 2,839 cases        |                    |
| Total—2,880 items                | Total—24,615 cases |

The daily man-hour cost for hand case cutting and for price marking 20 percent of the merchandise (6,150 cases) at the retail store is calculated as follows:

6,150 cases times 0.527 man-minutes divided by 60 minutes equals 54 man-hours.

The man-hours required at the warehouse for case opening and for price marking 80 percent of the merchandise (24,615 cases) are calculated as follows:

- One-case lots per item—14,202 times 0.1594 man-minutes<sup>4</sup> divided by 60 minutes equals 37.7 man-hours.
- Two-case lots per item—7,574 times 0.1466 man-minutes<sup>4</sup> divided by 60 minutes equals 18.5 man-hours.
- Three-case lots per item—2,839 times 0.1420 man-minutes<sup>4</sup> divided by 60 minutes equals 6.7 man-hours.

The daily man-hours required at the warehouse for mechanical price marking and for opening 80 percent of the cases (24,615) total 62.9 man-hours, and the time required for hand opening and pricing the contents of 20 percent of the cases—6,154—at the retail store totals 54.1 man-hours; the total time for both operations is 117 man-hours. Hand opening and pricing all the cases and case contents at the retail store requires a total of 270.3 man-hours. Thus, with mechanical pricing at the warehouse, man-hours would be reduced by more than 56 percent.

<sup>4</sup> Weighted elemental time per case as determined from appendix table 7, p. 19.

The annual cost for mechanically price marking 80 percent of the merchandise at the warehouse and 20 percent at the stores is as follows:

|                              |          |
|------------------------------|----------|
| Store labor—14,066 man-hours |          |
| at \$2.60 per hour.....      | \$36,572 |
| Warehouse labor—16,354 man-  |          |
| hours at \$3 per hour.....   | 49,062   |
| Annual equipment cost.....   | 2,864    |
| Annual building cost.....    | 8,225    |
| Total cost.....              | \$96,723 |

The total cost for mechanically price marking the merchandise at the warehouse in this example is \$96,723, whereas the total cost for hand opening and pricing all of the merchandise at the retail store is \$182,671. Thus, a potential annual saving of \$85,948—more than 47 percent—can be realized by using warehouse pricing. This saving amounts to 1.07 cents per case; for the grocery industry, which ships 5 billion cases per year, the savings would total \$53.5 million.

The estimated annual saving of \$85,948 made possible by warehouse pricing was calculated on the assumption that identical units of each item would receive an identical price mark. Appendix table 7 shows the effect of zone pricing, or marking identical units with different prices in accordance with the locality in which the units are to be sold. Whereas the daily warehouse time requirement for pricing 80 percent of the merchandise totals 62.9 man-hours when identical units are marked with the same price, total daily man-hours required increase to 87.4 when the units of an item must be divided for four price zones, each requiring a different price mark. Warehouse costs for four-zone pricing are estimated to total \$115,833 annually, compared with the estimated \$182,671 annual cost of pricing all of the merchandise at the retail store. When marking is required for four pricing zones instead of one, annual savings are reduced from \$85,948—47 percent—to \$66,838—37 percent. Thus, for the warehouse described in this study, with its assumed \$40 million annual business volume, the requirement of marking for four pricing zones would reduce the potential annual saving by nearly \$20,000.

## SUGGESTED OPERATING METHODS AND WAREHOUSE LAYOUT

The price-marking operating methods suggested in this section are based on data obtained during the study and on projections of realistic operating methods. No change is recommended in the normal warehouse procedure of storing receipts in fixed or floating slots. However, a total item-movement report should be prepared daily. The merchandise required each day for delivery to all stores can then be moved to the pricing station on pallets. After each item of merchandise is marked, it can be placed in the slots designated for each store, according to the store order. When the delivery trucks are ready for loading, each priced and assembled store order can be moved directly into the truck for delivery to the store.

Figure 9 shows a typical warehouse layout with *A* representing the pricing area and *B* representing the area where assembled priced merchandise is held before it is shipped to the retail stores.

The pricing station in figure 9 is placed near the floor slot area where fast-moving items are normally stored, thus providing these items with the shortest travel distance to the pricing stations. The area where priced merchandise selected by store order is placed is also adjacent to the pricing stations to keep travel distance at a minimum. Assembled orders can then be moved directly to the shipping dock for loading.

It is also possible to separate items in the warehouse that will be price marked and those that cannot be price marked. This separation will reduce the time required to assemble unpriced merchandise as well as merchandise that must be priced. Thus, figure 9 shows separate floor-slot areas; one, for holding fast-moving items that can be price marked, is located near the pricing station and the other area, for holding fast-moving items that will not be price marked at the warehouse, is located on the opposite side of the layout.

## CONSIDERATIONS WITH WAREHOUSE PRICE MARKING

Although pricing groceries at the central warehouse has been shown to be less costly than retail-store pricing, additional factors should be considered, such as methods for shipping split cases and handling price changes, effects of warehouse pricing on retail-store inventories, consumer reaction to the experimental multi-impression price marks, and the number of zone prices required.

### Shipping Split Cases

The system used for shipping dry grocery items from the warehouse to the retail store is designed to accommodate pallet or other unit loads of sealed, intact dry-grocery cases. The handling and transport of the opened and split cases produced by the mechanical price-marking process is one of the major problems associated with warehouse pricing. During this study, it was determined that opened or split cases loaded on mixed pallets cannot be transported from warehouse to retail store without

special handling. For such handling, each full case must be resealed and each split case must be wrapped, or these cases must be shipped in a container.

If prepriced dry grocery items are to be shipped from the warehouse to the retail store in large quantities, the grocery industry should direct attention to developing feasible methods of shipping opened and split cases. Promising approaches to the problem are already in existence; other approaches would undoubtedly be proposed if an influx of opened and split cases were introduced into the grocery transport system as a result of a wide-scale implementation of the central warehouse mechanical pricing process.

One possible solution is to assemble the priced merchandise in cages for shipment to retail stores. Cages provide support for cases on two ends, as shown in figure 10, and are already being used by a number of grocery firms.

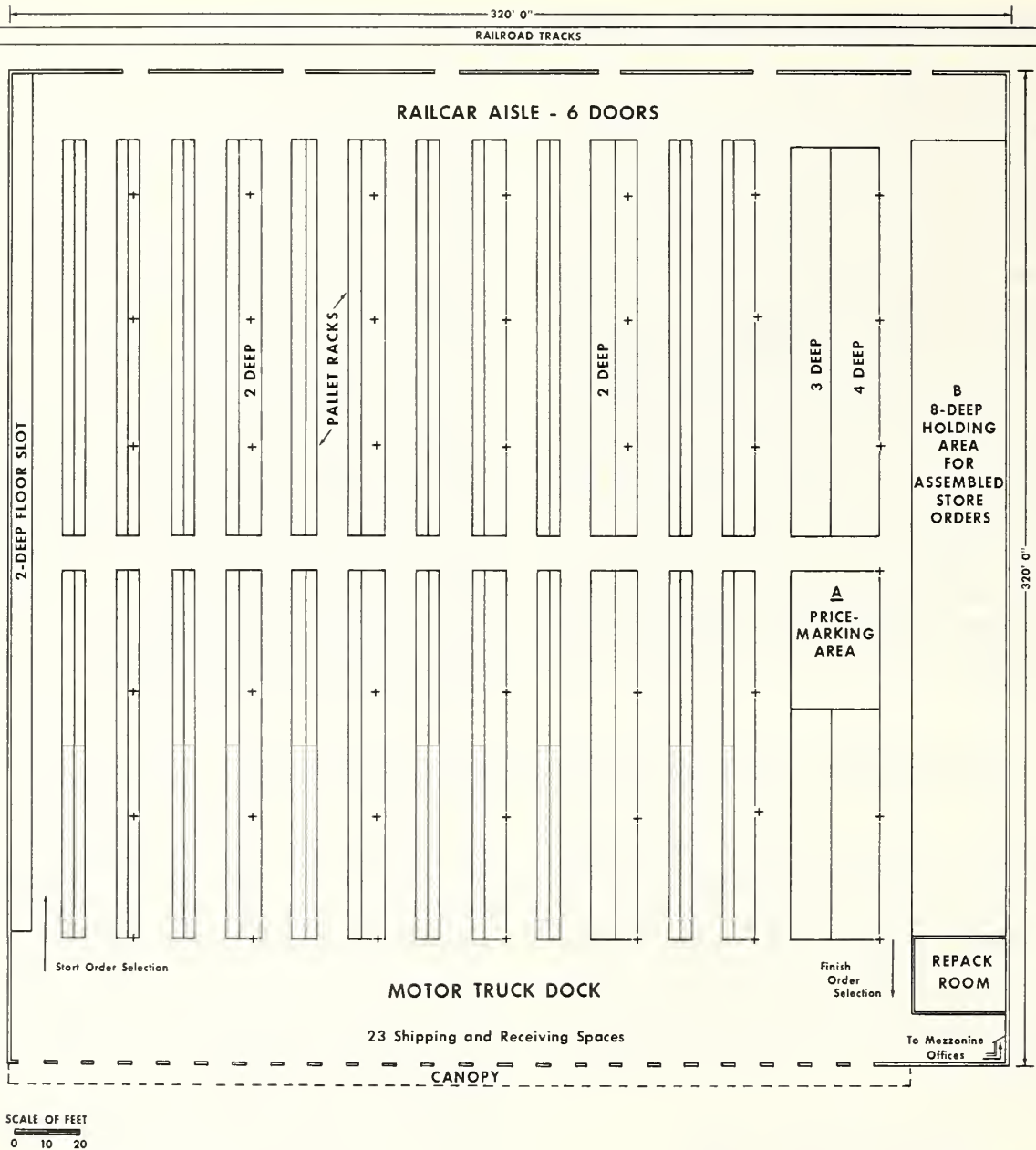


FIGURE 9.—A typical warehouse layout showing the pricing area (A), and the area (B), where assembled priced merchandise is held before shipment to retail stores.

A second possible solution is to use shrink film overwraps on opened or split cases. Although the economic feasibility of this method has yet to be determined, it offers advantages that indicate it might prove practical, such as the ease with which the film could be applied

to tray-cut cases of merchandise, and the ease with which it could be removed from nonintact cases at the retail store.

Another possibility is to use metal or tape bands to hold the tops of single-layer cases and the two halves of double-layer cases in place.



BN-36561

FIGURE 10.—Grocery orders assembled in cages for shipment to retail stores.

Research is needed to determine the feasibility of this method.

Research is needed to determine which of these methods is most practical for handling and shipping prepriced groceries sent from the warehouse to the retail store. Possibly, other solutions will be advanced that are more satisfactory than the ones described. However, the fact that promising approaches to the problem of transporting opened and split cases already exist should encourage continuing interest in a pricing process that would make the transport of such cases a routine function.

### Handling Price Changes

Another major problem associated with warehouse mechanical pricing is caused by the grocery industry's policy of making frequent price changes. This policy imposes a costly and time-consuming burden on the retailer, and his repricing problems would be intensified if his merchandise were to be prepriced with the multi-impression mechanical price marker. During this study, the multi-impression price marker was determined to be the most efficient and productive mechanical marker available. However, this device covers the entire top surfaces of the items it prices with alternate rows of price figures that would be harder to change than conventional single price marks.

Four corporate food chains, a retailer-owned cooperative wholesaler, and a voluntary-group wholesaler were interviewed to determine how

price changes influenced their opinions about the feasibility of central-warehouse pricing. The voluntary-group wholesale organization stated it had no control over retail-store pricing policy. Three corporate food-chain organizations reported a twice-weekly frequency of price changes, and one chain store and the cooperative wholesaler stated price changes were made once weekly. All five organizations included promotions, deals, increased cost, reduced cost, and competition among the reasons advanced for price changing, a practice that affected from 2 to 5 percent of the items handled by these organizations each week.

The effect of price-changing policies on managements' receptiveness to warehouse price marking could not be clearly defined. Although the cost of repricing grocery products would probably increase with warehouse pricing, the amount of increase could not be determined from available information. Two factors that would affect repricing costs are the type of price-marking equipment used in the warehouse and the type of inventory control maintained by retail-store management. Further research is needed to determine whether the efficiency and high productivity of the multi-impression price marker compensate for the increase in man-hours that would be required for changing the type of price mark produced by this equipment. Possibly, an economical and efficient mechanical price marker could be developed that would provide a type of price mark designed to facilitate the price-changing requirements. Repricing costs would probably be increased, also, for the retail-store manager who failed to maintain a good inventory control system. The relation between warehouse mechanical pricing and retail inventory control is discussed in the next section of this paper.

In the opinion of several of the retail firms interviewed, costs associated with price changes and repricing could be minimized if retailers would allow the inventory already on the store shelves to become depleted before changing prices. Some of the firms stated that if a price change were to affect both backroom and shelf inventory, they would reprice the backroom inventory only and would not restock this inventory until it was nearly depleted.

## Effects of Warehouse Pricing on Retail Inventories

Little evidence was found during this study to indicate that the central warehouse mechanical price-marking process offers a better system of inventory control than that offered by other good inventory control systems. However, the process would in all probability encourage the maintenance of sound retail inventory management because such management offers the best means of alleviating the problems imposed by price-changing requirements.

In modern food distribution procedure, increasing emphasis is being placed on moving grocery items to the retail-store shelf with minimum storage time. A good inventory control system can be defined as one that maintains inventory levels with minimum quantity of out-of-stock product and with minimum quantity of product in backroom storage. Because the vulnerability of merchandise to price changes increases with the amount of time that it remains in stock, the retailer can avoid excessive repricing requirements by maintaining a good inventory control system that minimizes time lapses between retail order preparation and retail shelf stocking.

The most important advantage that the warehouse mechanical price-marking process offers to retail inventory control is that it would make half-case quantities of merchandise available for retail order filling. One cooperating firm interviewed during this study reported that, in general, 75 percent of all items handled sell in quantities of less than one-half case a week and that 90 percent of all items sell in quantities of less than a full case a week. Because the retailer must order in full-case quantities, slower moving items frequently become overstocked in the backroom, where they are particularly vulnerable to price changes. These slower moving items increase backroom handling problems, and they also cause problems in shelf-space allocation. Generally, the retailer allocates shelf space so that each allotted space will accommodate a full case of an individual item's units. This practice reduces the time and effort required to search for small quantities of merchandise in the backroom, and to trans-

port less-than-caseload quantities between the shelf and the backroom.

Because double-layer cases must be split in half during the mechanical price-marking process, half cases of merchandise would be routinely produced in warehouses that used this process. If the problems involved in transporting split cases were to be solved by the development of warehouse mechanical pricing, the retailer should be able to order much of his dry-grocery stock in half-case quantities. He should then be able to avoid much of the additional handling and repricing required for his slower moving merchandise. He should also be able to reallocate his shelf space in accordance with the sales performance of specific items, and thus accelerate sales in store areas with concentrations of slow-moving items. By reallocating his shelf space to accord with half-case unit quantities, the retailer might be able to offer his customers merchandise not previously carried in his stock.

## Consumer Reaction to Multi-Impression Mechanical Price Marks

The multi-impression price marker's technique of covering the entire top surface of the product with alternately placed large and small price impressions (fig. 4) motivated additional research aimed at determining whether the consumer would find this type of price impression hard to grasp or hard to read.

A consumer acceptance test was set up in one supermarket for a 1-week period. During this period, the store's customers were allowed to choose between units of selected items that had been priced with hand stamps, and similar units that had been priced with the multi-impression mechanical marker. No significant statistical difference was found between the produce movement of items priced by hand and units priced by machine. (None of the units used in the test included repriced merchandise because the new prices would not have been applied by the multi-impression mechanical price marker, and the test was designed to determine consumer reaction to the specific type of price mark produced by this marker.)

At the conclusion of the test, the store manager was interviewed to determine what prob-

lems, if any, had been encountered in connection with the price marks produced by the multi-impression price marker. No problems were reported. Further, no verbal complaints from customers were reported by the employees at the checkout counter and no complaints from the checkers were reported by the management. It was concluded that the customer was not confused by the multiple impression type of price mark, and was satisfied with the legibility of the mechanically produced prices. To judge from this test, the customer is impartial to the type of price mark used in the retail store, as long as he finds it easy to read.

## Extent of Zone Pricing

As indicated previously, the extent of zone pricing will influence the amount of savings realized with central warehouse pricing. In the grocery warehouse used for illustration, which presumably ships 30,769 cases daily and has a \$40 million annual volume, the necessity of marking for four zone prices would reduce potential annual savings from central warehouse pricing by more than 22 percent (\$20,000 annually). Accordingly, zone pricing is a major consideration in determining feasibility and profitability of warehouse pricing.

## NEED FOR ADDITIONAL RESEARCH

This research covered only one part of a complete grocery-distribution system—the price-marking function. However, the study has implications for several other areas in the handling of grocery products and shows a need for further research.

One of the major problems that confronts the food industry in connection with warehouse price marking is price changing. Research is needed to determine the feasibility of developing an improved mechanical price marker that would produce a price mark designed to facilitate price changes. Research on price-change policies and repricing costs is also needed. Is price changing profitable? What items should be repriced? What increases in volume are necessary to pay for the labor and material used for repricing? What does it cost to reprice at the retail store? The answers to these questions are vital to the food industry and might easily change modern price-changing practices in the retail food industry.

Findings for this study indicate that the case-opening operation requires more labor than the pricing operation. Equipment manufacturers interviewed during the study indicated that “automatic” case openers could be designed. What effect would automatic case opening have on automated price marking? Research in carton design directed toward producing cartons that can be opened without cutting should be considered. Another possibility is for whole-

salers to receive merchandise in bulk and to pack it in containers or cartons only after the price-marking operation.

Price marking at the warehouse has many effects on warehouse design and layout. What modifications are necessary if a warehouse is to obtain maximum efficiency? Modifications of plant design, product storage layout, and traffic flow within the warehouse must be studied if these maximum efficiencies are to be realized.

In one test, losses caused by errors at the checkout counter totaled 0.64 percent of sales. If this loss is typical, it would be the equivalent of 39 percent of profits before taxes (4). Warehouse price marking should have a positive impact on reducing checkout errors. Studies of the effects of warehouse price marking on “front-end” efficiencies would be beneficial for determining the feasibility of this method of pricing.

Warehouse price marking has been restricted to dry grocery items. Can this system be used for pricing all items in supermarkets? What modifications must be made in equipment, inks, and operating layout to extend its use?

The future holds many potential innovations in grocery warehousing. Optical scanning cash registers are in the development stage. The optical-scanning system requires that a code be placed on each item. Would it be economically feasible to modify existing central price-mark-

ing equipment so that codes could be placed on individual units, either at the retail store or at the warehouse? If so, what other problems

would be encountered, and how would they affect the economic feasibility of a coded central price-marking system?

## LITERATURE CITED

- (1) BARNES, R. M.  
1958. *motion and time study*. Ed. 4, 665 pp., New York.
- (2) BARTZ, DANIEL J., and ASSOCIATES.  
1968. *wholesale food distributors annual financial comparisons*. 79 pp. Milwaukee.
- (3) BARTZ, D. J., CATEL, J. N., and BOUMA, J. C.  
1967. *use of adhesive labels for price-marking cases at the warehouse*. U.S. Agri. Res. Serv. ARS 52-23, 19 pp., illus.
- (4) HARWELL, E. M.  
1963. *checkout management*. 230 pp. New York.
- (5) ——— and SHAFFER, P. F.  
1952. *some improved methods of handling groceries in self-service retail food stores*. U.S. Dept. Agr. Market. Res. Rpt. 7, 118 pp., illus.
- (6) PROGRESSIVE GROCER.  
1970. *thirty-seventh annual report of the grocery industry*. Progressive Grocer 49 (4): 75, illus.
- (7) SHAFFER, P. F., BOUMA, J. C., KARITAS, J. J., and FLYNN, GORDON.  
1961. *handling groceries from warehouse to retail store shelves*. U.S. Dept. Agr. Market. Res. Rpt. 473, 47 pp., illus.

## APPENDIX

TABLE 4.—Standard time required to cut single-layer cases of various sizes by machine

| Man-minutes required when length of case is— |           |           |           |           |           |           |           |           |           |           |           |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Width of case (inches)                       | 10 inches | 11 inches | 12 inches | 13 inches | 14 inches | 15 inches | 16 inches | 17 inches | 18 inches | 19 inches | 20 inches |
| 8.00   | 0.106     | 0.110     | 0.114     | 0.118     | 0.122     | 0.125     | 0.129     | 0.133     | 0.137     | 0.141     | 0.144     |
| 8.50   | .108      | .112      | .116      | .120      | .124      | .127      | .131      | .135      | .139      | .143      | .146      |
| 9.00   | .110      | .114      | .118      | .122      | .125      | .129      | .133      | .137      | .141      | .144      | .148      |
| 9.50   | .112      | .116      | .120      | .124      | .127      | .131      | .135      | .139      | .143      | .146      | .150      |
| 10.00  | .114      | .118      | .122      | .125      | .129      | .133      | .137      | .141      | .144      | .148      | .152      |
| 10.50  | .116      | .120      | .124      | .127      | .131      | .135      | .139      | .143      | .146      | .150      | .154      |
| 11.00  | .118      | .122      | .125      | .129      | .133      | .137      | .141      | .144      | .148      | .152      | .156      |
| 11.50  | .120      | .124      | .127      | .131      | .135      | .139      | .143      | .146      | .150      | .154      | .158      |
| 12.00  | .122      | .125      | .129      | .133      | .137      | .141      | .144      | .148      | .152      | .156      | .160      |
| 12.50  | .124      | .127      | .131      | .135      | .139      | .143      | .146      | .150      | .154      | .158      | .162      |
| 13.00  | .125      | .129      | .133      | .137      | .141      | .144      | .148      | .152      | .156      | .160      | .163      |
| 13.50  | .127      | .131      | .135      | .139      | .143      | .146      | .150      | .154      | .158      | .162      | .165      |
| 14.00  | .129      | .133      | .137      | .141      | .144      | .148      | .152      | .156      | .160      | .163      | .167      |
| 14.50  | .131      | .135      | .139      | .143      | .146      | .150      | .154      | .158      | .162      | .165      | .169      |
| 15.00  | .133      | .137      | .141      | .144      | .148      | .152      | .156      | .160      | .163      | .167      | .171      |
| 15.50  | .135      | .139      | .143      | .146      | .150      | .154      | .158      | .162      | .165      | .169      | .173      |
| 16.00  | .137      | .141      | .144      | .148      | .152      | .156      | .160      | .163      | .167      | .171      | .175      |

TABLE 5.—Specifications for equipment used to open cases and price mark case contents

| Equipment                      | Length                   | Width                    | Height                   | Weight                 | Cost       |
|--------------------------------|--------------------------|--------------------------|--------------------------|------------------------|------------|
| Single-impression price marker | 12 ft. 3 in.             | 3 ft.                    | 5 ft. 10 in.             | <sup>1</sup> 2,000 lb. | \$8,800.00 |
| Multi-impression price marker  | <sup>2</sup> 7 ft. 9 in. | 3 ft. 4 in.              | 5 ft. 10 in.             | <sup>1</sup> 750 lb.   | 4,700.00   |
| All-purpose case opener        | 3 ft. 7 in.              | 2 ft. 1 in.              | 4 ft. 9 in.              | 150 lb.                | 550.00     |
| Case divider                   | 10 ft.                   | <sup>3</sup> 3 ft. 6 in. | ( <sup>4</sup> )         | ( <sup>4</sup> )       | 1,200.00   |
| 10-foot section wheel conveyor | 10 ft.                   | 18 in.                   | ( <sup>4</sup> )         | 92 lb.                 | 53.60      |
| Conveyor stand                 | ( <sup>4</sup> )         | ( <sup>4</sup> )         | <sup>5</sup> 5 ft. 6 in. | 13 lb.                 | 9.10       |
| Case stop control              | ( <sup>4</sup> )         | ( <sup>4</sup> )         | ( <sup>4</sup> )         | ( <sup>4</sup> )       | 54.00      |

<sup>1</sup> Approximate weight.

<sup>2</sup> When work table is included, overall length is 11 feet 4 inches.

<sup>3</sup> Depends on width of conveyor.

<sup>4</sup> Not applicable.

<sup>5</sup> Maximum height.

TABLE 6.—*Standard time required for price-marking dry grocery items by machine*

| Width<br>of<br>case<br>(inches) | Man-minutes required for mechanically pricing— |        |         |        |         |        |          |        |          |        |          |        |           |        |
|---------------------------------|--|--------|---------|--------|---------|--------|----------|--------|----------|--------|----------|--------|-----------|--------|
|                                 | 1 case   |        | 2 cases |        | 5 cases |        | 10 cases |        | 30 cases |        | 70 cases |        | 100 cases |        |
|                                 | Single   | Double | Single  | Double | Single  | Double | Single   | Double | Single   | Double | Single   | Double | Single    | Double |
| 8.00                            | .01728   | .01896 | .00948  | .01116 | .00480  | .00648 | .00324   | .00492 | .00220   | .00388 | .00190   | .00358 | .00184    | .00352 |
| 8.50                            | .1739  | .1917  | .0959   | .1137  | .0491   | .0669  | .0335    | .0513  | .0231    | .0409  | .0201    | .0374  | .0195     | .0373  |
| 9.00                            | .1749  | .1938  | .0969   | .1158  | .0501   | .0690  | .0345    | .0534  | .0241    | .0430  | .0211    | .0400  | .0205     | .0394  |
| 9.50                            | .1760  | .1959  | .0910   | .1179  | .0512   | .0711  | .0356    | .0555  | .0252    | .0451  | .0222    | .0421  | .0216     | .0415  |
| 10.00                           | .1770  | .1980  | .0990   | .1200  | .0522   | .0732  | .0366    | .0576  | .0262    | .0472  | .0232    | .0442  | .0226     | .0436  |
| 10.50                           | .1781  | .2001  | .1001   | .1221  | .0533   | .0753  | .0377    | .0597  | .0273    | .0493  | .0243    | .0463  | .0237     | .0457  |
| 11.00                           | .1791  | .2022  | .1011   | .1242  | .0543   | .0774  | .0387    | .0618  | .0283    | .0514  | .0253    | .0484  | .0247     | .0478  |
| 11.50                           | .1802  | .2043  | .1022   | .1263  | .0554   | .0795  | .0398    | .0639  | .0294    | .0535  | .0264    | .0505  | .0257     | .0499  |
| 12.00                           | .1812  | .2064  | .1032   | .1284  | .0564   | .0816  | .0408    | .0660  | .0304    | .0556  | .0274    | .0526  | .0268     | .0520  |
| 12.50                           | .1823  | .2085  | .1043   | .1305  | .0575   | .0837  | .0419    | .0681  | .0315    | .0577  | .0285    | .0547  | .0279     | .0541  |
| 13.00                           | .1833  | .2106  | .1053   | .1376  | .0585   | .0858  | .0429    | .0702  | .0325    | .0598  | .0295    | .0568  | .0289     | .0562  |
| 13.50                           | .1844  | .2127  | .1064   | .1247  | .0596   | .0879  | .0440    | .0723  | .0336    | .0619  | .0306    | .0589  | .0300     | .0583  |
| 14.00                           | .1854  | .2148  | .1074   | .1268  | .0606   | .0900  | .0450    | .0744  | .0346    | .0640  | .0316    | .0610  | .0310     | .0604  |
| 14.50                           | .1865  | .2169  | .1085   | .1289  | .0617   | .0921  | .0461    | .0765  | .0357    | .0661  | .0327    | .0631  | .0321     | .0625  |
| 15.00                           | .1875  | .2190  | .1095   | .1310  | .0627   | .0942  | .0471    | .0786  | .0367    | .0682  | .0337    | .0652  | .0331     | .0646  |
| 15.50                           | .1886  | .2211  | .1106   | .1331  | .0638   | .0963  | .0482    | .0807  | .0378    | .0703  | .0348    | .0673  | .0342     | .0667  |
| 16.00                           | .1896  | .2232  | .1116   | .1452  | .0648   | .0984  | .0492    | .0828  | .0380    | .0724  | .0358    | .0694  | .0352     | .0689  |

TABLE 7.—*Computed warehouse time requirement for mechanical case opening and price marking: 24,165 cases of dry grocery items marked for 1 through 4 pricing zones*<sup>1</sup>

| Procedures in cutting cases and price marking case contents                        | Time<br>required<br>for 1 zone,<br>6.575 cases | Time<br>required<br>for 2 zones,<br>3.29 cases | Time<br>required<br>for 3 zones,<br>2.19 cases | Time<br>required<br>for 4 zones,<br>1.64 cases |
|--|--|--|--|--|
| By machine—one case item:  |  |  |  |  |
| Double-layer cases—  |  |  |  |  |
| Adjust case cutter.....  | man-min./case                                  | .00058   | .00115   | .00174   |
| Cut case in half.....  | do.  | .1319  | .1319  | .1319  |
| Total time required to adjust case cutter and cut case in half.....                | do.  | .1377  | .1434  | .1493  |
| Weighted time for double-layer cases (70 pct. of total time).....                  | do.  | .0964  | .1004  | .1045  |
| Single-layer cases—  |  |  |  |  |
| Adjust cutter.....   | man-min./case                                  | .0058  | .0115  | .0174  |
| Remove top.....  | do.  | .0865  | .0865  | .0865  |
| Total time required to adjust case cutter and remove top.....                      | do.  | .0923  | .0980  | .1039  |
| Weighted time for single-layer cases (30 pct. of total time).....                  | do.  | .0277  | .0294  | .0312  |
| Total time required for mechanical procedures.....                                 | do.  | .1241  | .1298  | .1357  |
| Price marking  |  |  |  |  |
| Change price roll (by hand).....   | do.  | .0237  | .0474  | .0712  |
| Total time required for mechanical procedures and changing price roll by hand..... | do.  | .1478  | .1772  | .2069  |
| Total time required for 12,427 cases:  |  |  |  |  |
| Man-minutes.....   | 1,837  | 2,202  | 2,571  | 2,940  |
| Man-hours.....   | 30.6   | 36.7   | 42.8   | 49.0   |
| By hand—one case item:   |  |  |  |  |
| Double-layer cases—  |  |  |  |  |
| Cut case in half.....  | man-min./case                                  | .2590  | .2590  | .2590  |
| Weighted time for double-layer cases (70 pct. of total time).....                  | do.  | .1813  | .1813  | .1813  |
| Single-layer cases—  |  |  |  |  |
| Remove top.....  | man-min./case                                  | .1970  | .1970  | .1970  |
| Weighted time for single-layer cases (30 pct. of total time).....                  | do.  | .0591  | .0591  | .0591  |

See footnote at end of table.

TABLE 7.—*Computed warehouse time requirement for mechanical case opening and price marking: 24,165 cases of dry grocery items marked for 1 through 4 pricing zones*<sup>1</sup>—Continued

| Procedures in cutting cases and price marking case contents                              | Time<br>required<br>for 1 zone,<br>13.15 cases | Time<br>required<br>for 2 zones,<br>6.58 cases | Time<br>required<br>for 3 zones,<br>4.38 cases | Time<br>required<br>for 4 zones,<br>3.29 cases |
|--|--|--|--|--|
| By hand—one case item—Continued:   |  |  |  |  |
| Total time required for hand-performed procedures.....do.                                | .2404  | .2404  | .2404  | .2404  |
| Total hand-time required for 1,775 cases:  |  |  |  |  |
| Man-minutes.....   | 427  | 427  | 427  | 427  |
| Man-hours.....   | 7.1  | 7.1  | 7.1  | 7.1  |
| Total time required for 14,202 cases:  |  |  |  |  |
| Man-minutes.....   | 2,264  | 2,664  | 2,998  | 3,376  |
| Man-hours.....   | 37.7   | 43.8   | 49.9   | 56.1   |
| By machine—two case items:   |  |  |  |  |
| Double layer cases—  |  |  |  |  |
| Adjust case cutter.....man-min./case   | .0029  | .0058  | .0087  | .0115  |
| Cut case in half.....do.   | .1319  | .1319  | .1319  | .1319  |
| Total time required to adjust case cutter and cut case in half....do.                    | .1348  | .1377  | .1406  | .1434  |
| Weighted time for double-layer cases (70 pct. of total time).....do.                     | .0944  | .0962  | .0984  | .1004  |
| Single-layer cases—  |  |  |  |  |
| Adjust cutter.....man-min./case  | .0029  | .0058  | .0087  | .0115  |
| Remove top.....do.   | .0865  | .0865  | .0865  | .0865  |
| Total time required to adjust case cutter and remove top....do.                          | .0894  | .0923  | .0952  | .0980  |
| Weighted time for single-layer cases (30 pct. of total time).....do.                     | .0268  | .0277  | .0286  | .0294  |
| Total time required for mechanical procedures.....do.                                    | .1212  | .1239  | .1270  | .1298  |
| Price marking  |  |  |  |  |
| Change price roll (by hand).....do.  | .0119  | .0237  | .0356  | .0474  |
| Total time required for mechanical procedures and changing<br>price roll by hand.....do. | .1331  | .1476  | .1626  | .1772  |
| Total time required for 6,627 cases:   |  |  |  |  |
| Man-minutes.....   | 882  | 978  | 1,077  | 1,174  |
| Man-hours.....   | 14.7   | 16.3   | 18.0   | 19.6   |
| By hand—two case items:  |  |  |  |  |
| Double-layer cases—  |  |  |  |  |
| Cut case in half.....man-min./case   | .2590  | .2590  | .2590  | .2590  |
| Weighted time for double-layer cases (70 pct. of total time).....do.                     | .1813  | .1813  | .1813  | .1813  |
| Single-layer cases—  |  |  |  |  |
| Remove top.....man-min./case   | .1970  | .1970  | .1970  | .1970  |
| Weighted time for single-layer cases (30 pct. of total time).....do.                     | .0591  | .0591  | .0591  | .0591  |
| Total time required for hand-performed procedures.....do.                                | .2404  | .2404  | .2404  | .2404  |
| Total time required for 947 cases:   |  |  |  |  |
| Man-minutes.....   | 228  | 228  | 228  | 228  |
| Man-hours.....   | 3.8  | 3.8  | 3.8  | 3.8  |

See footnote at end of table.

TABLE 7.—*Computed warehouse time requirement for mechanical case opening and price marking: 24,615 cases of dry grocery items marked for 1 through 4 pricing zones*<sup>1</sup>—Continued

| Procedures in cutting cases and price marking case contents                            | Time<br>required<br>for 1 zone,<br>19.72 cases | Time<br>required<br>for 2 zones,<br>9.86 cases | Time<br>required<br>for 3 zones,<br>6.58 cases | Time<br>required<br>for 4 zones,<br>4.93 cases |
|--|--|--|--|--|
| By hand—two case item—Continued:   |  |  |  |  |
| Total time required for 7,574 cases:   |  |  |  |  |
| Man-minutes.....   | 1,110  | 1,206  | 1,305  | 1,402  |
| Man-hours.....   | 18.5   | 20.1   | 21.8   | 23.4   |
| By machine—three case items:   |  |  |  |  |
| Double-layer cases—  |  |  |  |  |
| Adjust case cutter..... man-min./case  | .0019  | .0039  | .0058  | .0077  |
| Cut case in half..... do.  | .1319  | .1319  | .1319  | .1319  |
| Total time required to adjust case cutter and cut case in half.... do.                 | .1338  | .1358  | .1377  | .1396  |
| Weighted time for double-layer cases (70 pct. of total time)..... do.                  | .0937  | .0951  | .0964  | .0977  |
| Single-layer cases—  |  |  |  |  |
| Adjust cutter..... man-min./case   | .0019  | .0039  | .0058  | .0077  |
| Remove top..... do.  | .0865  | .0865  | .0865  | .0865  |
| Total time required to adjust case cutter and remove top..... do.                      | .0884  | .0904  | .0923  | .0942  |
| Weighted time for single-layer cases (30 pct. of total time)..... do.                  | .0265  | .0271  | .0277  | .0283  |
| Total time required for mechanical procedures..... do.                                 | .1202  | .1222  | .1241  | .1260  |
| Price marking  |  |  |  |  |
| Change price roll (by hand)..... do.   | .0079  | .0158  | .0237  | .0316  |
| Total time required for mechanical procedures and changing price roll by hand..... do. | .1281  | .1380  | .1478  | .1576  |
| Total time required for 2,484 cases:   |  |  |  |  |
| Man-minutes.....   | 318  | 343  | 367  | 391  |
| Man-hours.....   | 5.3  | 5.7  | 6.1  | 6.5  |
| By hand—three case items:  |  |  |  |  |
| Double-layer cases—  |  |  |  |  |
| Cut case in half..... man-min./case  | .2590  | .2590  | .2590  | .2590  |
| Weighted time for double-layer cases (70 pct. of total time)..... do.                  | .1813  | .1813  | .1813  | .1813  |
| Single-layer cases—  |  |  |  |  |
| Remove top..... man-min./case  | .1970  | .1970  | .1970  | .1970  |
| Weighted time for single-layer cases (30 pct. of total time)..... do.                  | .0591  | .0591  | .0591  | .0591  |
| Total time required for hand-performed procedures..... do.                             | .2404  | .2404  | .2404  | .2404  |
| Total hand-time required for 355 cases:  |  |  |  |  |
| Man-minutes.....   | 85   | 85   | 85   | 85   |
| Man-hours.....   | 1.4  | 1.4  | 1.4  | 1.4  |
| Total time required for 2,839 cases:   |  |  |  |  |
| Man-minutes.....   | 403  | 428  | 452  | 476  |
| Man-hours.....   | 6.7  | 7.1  | 7.5  | 7.9  |
| Total time required for 24,651 cases:  |  |  |  |  |
| Man-hours.....   | 62.9   | 71.0   | 79.2   | 87.4   |

<sup>1</sup> Equal numbers of cases are assigned to each pricing zone.

UNITED STATES DEPARTMENT OF AGRICULTURE  
Agricultural Research Service  
Hyattsville, Maryland 20782

Official Business  
Penalty for Private Use, \$300



POSTAGE & FEES PAID  
United States Department of Agriculture